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Fat-pad impingement after total knee arthroplasty with the LCS A/P-Glide system

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Abstract Early follow-up (15.8 months;1–48) of 230 knee replacements with an LCS A/P Glide component indicated an increased occurrence of anterior knee pain due to a fat-pad impingement, necessitating early revision surgery. Unsatisfactory results were observed in 28 knees (12.2%). Thirteen knees (5.7%) were revised on finding the fat-pad impingement, and four knees (1.7%) were scheduled for later revision surgery; the remaining 11 subjects (4.8%) had revision surgery for a different reason. Twenty-six subjects (11.3%) complained about milder but typical symptoms of a fat-pad impingement, and 22 subjects (9.6%) had unspecific mild symptoms. 151 knees (65.7%) were free of pain and demonstrated an excellent result. The total revision rate of 10.4% (24 knees) is higher than described for other implant systems. However, the revision needed to treat the fat-pad impingement (5.7%) consisted of minor surgery only, such as exchange of the mobile bearing or reduction of the fat pad by arthroscopy. The femoral and tibial components were able to be left untouched. Resection of the Hoffa's fat pad is recommended when such an implant system is used, and possible impingement should be investigated intraoperatively before closure.

Keywords Knee · Arthroplasty · Fat-pad impingement · Hoffa's disease · Revision surgery

Introduction

The use of mobile bearing implant systems such as the LCS (low contact stress) knee (DePuy AG, Cham, Switzerland) for total knee replacements has proven to be very successful with an excellent long-term survivorship history [3]. After the introduction of the A/P-Glide tibial component, a posterior cruciate retaining design, an increase of complaints about persisting anterior knee pain was observed postoperatively, which led to further investigations. In this work we present the early follow-up results for 230 knees. To illustrate the soft-tissue irritation, five cases were studied with a PET 18F-FDG scan in a pilot project prior to revision surgery.

The aim of this publication is to communicate the higher-than-usual revision rate, to demonstrate the intraoperative findings of fat-pad impingement and to describe the typical symptoms.

Methods

Subjects

During a four-year period, 230 knee replacements with the LCS A/P-Glide bearing were performed in 218 subjects. The subjects were followed prospectively. Standard follow-up consultations were performed 3, 6 and 24 months postoperatively. Additional consultations were needed in the symptomatic cases. The clinical and radiological data was fed into a database using IDES software. The rate of revision surgery was documented. The decision to undertake revision surgery was made according to the severity of symptoms and the clinical findings. The reason for revision was documented on the clinical chart and the surgery protocol.

Table 1 Follow-up results of the 230 knees with the A/P-Glide system

Patient status	Time since surgery (months)	*n*	%
Pain free, excellent result	16.4 (SD 10.3, range 2–48)	151	65.7%
Symptoms of fat pad impingement			
Mild to moderate anterior knee pain, tenderness of the Hoffa's fat pad, no revision necessary at the time. Satisfactory result	16.1 (SD 9.1, range 5 – 46	26	11.3%
Revision surgery recommended, fat-pad impingement anticipated	15.8 (SD 5.68, range 12 – 24	4	1.7%
Revision surgery performed, fat-pad impingement confirmed	14.5 (SD 6.7, range 6 – 33	13	5.7%
Other symptoms			
Mild-to-moderate symptoms not typical for a fat-pad impingement. Satisfactory result	14.8 (SD 8.89, range 5 – 32	22	9.6%
Revision surgery performed for different reasons: progressive ligament insufficiency (*n*=3), arthrofibrosis (*n*=2), tibial component loosening (*n*=2), patella revision (*n*=1), other (*n*=3)	12.7 (SD 9.68, range 2.5 – 35	11	4.8%
Died during the observation period		2	0.9%
Lost to follow up		1	0.4%

Implant design: LCS A/P-Glide

The components include a cobalt chrome tibial tray, an ultra high molecular weight polyethylene bearing and a combination polyethylene and cobalt chrome control arm. The design rationale is to allow simultaneous axial rotation and anterior/posterior translation of the polyethylene tibial bearing relative to the fixed metal tray. Medial/lateral motion is constrained in the same manner as the existing rotating-platform knee. The A/P Glide tibial component is kinematically equivalent to the meniscal bearing component, in that they have the same degrees of freedom. However, the design characteristics reduce the potential for bearing dislocation when compared to the existing mobile-bearing design, without compromising kinematics, contact stress or range of movement.

Pilot PET-scan study

In a pilot project, five subjects already scheduled for revision surgery had access to a PET 18F-FDG scan. The objective of this pilot project was to study subjects with soft tissue irritation due to a mechanical problem which will be verified during surgery, in order to investigate if this method might be suitable to detect mechanical irritations. Positron emission tomography (PET) with 18-Fluoro-2-deoxy-D-glucose (FDG), a glucose analogon, is a diagnostic method based on the imaging of positron emission of Fluor-18. FDG uptake is increased in cells with high glucose consumption and accumulates as phosphorylated FDG-6Phosphate. An increase in FDG uptake is therefore found in neoplastic cells, making this method a valuable diagnostic tool in staging and therapy monitoring of various tumours [11, 22]. It has been shown that FDG-PET can also be used for imaging of patients with acute inflammatory or infectious diseases, as activated granulocytes, leukocytes and macrophages metabolise FDG to a higher degree [1, 2, 21, 23]. For this study, all patients fasted at least 4 to 6 hours prior to the FDG-PET scan. The patients' position was supine. The scanner employed was a whole-body PET scanner (GE Advance, GE Medical System, Waukesha, WI, USA). Data acquisition started 30 min after intravenous injection of at least 280 MBq of 18-Fluoro-2-deoxy-D-glucose (manufactured in-house). Two bed positions were acquired, centred at the knee joint. Transaxial images were reconstructed using filtered backprojection (Hanning filter with a 4 mm cut-off, 128×128 matrix, 2.34×2.34×4.25 mm voxel size). Images were displayed in coronal, sagittal and transversal planes. The contralateral knee was used as individual control.

Fig. 1 An anterior position of the A/P-Glide bearing is seen in flexion, with decreased space for the fat pad between the anterior edge of the A/P-Glide bearing and the patellar ligament or the distal patellar pole. The *arrow* indicates the prominent anterior border of the polyethylene

Results

During the period of observation, follow-up information was available for all except one subject (see Table 1). The average postoperative observation period was 15.8 months (1–48). Two subjects died for reasons unrelated to the surgery. Thirteen patients (5.7%) had revision surgery when a fat-pad impingement was found intraoperatively. Revision surgery included the resection of the Hoffa's fat pad and posterior cruciate ligament, and the exchange of the A/P-Glide bearing for a rotating-platform bearing in 12 cases. In one case with milder symptoms an arthroscopic reduction of the fat pad was performed. The tibial and

Table 2 PET-18F-FDG findings

Case HJ	Increased FDG uptake was seen at the antero-lateral border of the patella of the symptomatic knee fitted with the A/P-Glide system. An expansion into the cranial recessus was noted. There was no uptake on the contralateral side, where the patient was fitted with an unicondylar arthroplasty
Case OD	Increased FDG uptake was seen on the lateral aspect of the knee and in the central intercondylar part
Case GA	Increased FDG uptake was seen in the anterolateral and medial region of the symptomatic knee fitted with the A/P-Glide system. Only minimal uptake was noted in the contralateral knee, which was also fitted with a A/P-Glide system, which was, however, pain-free
Case HE	Increased FDG uptake was seen in the anterolateral region of the symptomatic knee
Case BA	Increased FDG uptake was noted on the medial and lateral side as well as in the suprapatellar and infrapatellar region of the knee fitted with the A/P-Glide system

femoral components were able to be left untouched in all revised cases. Revision surgery was deferred in four cases (1.7%). A further 26 patients (11.3%) complained about mild or moderate anterior knee pain of the same nature as the revised ones – suggesting a fat-pad impingement – which did not necessitate a surgical revision at that time. Eleven subjects (4.8%) had revision surgery for a different reason (see Table 1) without clinical signs of a fat-pad impingement. In those subjects, no imprints were found in the fat pad. The reason for revision surgery in those subjects was: (a) progressive ligament insufficiency (n=3), (b) arthrofibrosis (n=2), (c) tibial component loosening (n=2), (d) patella revision (n=1), and (e) other (n=3). Twenty-two subjects (9.6%) had mild or moderate symptoms which were not typical for a fat-pad impingement and which did not necessitate treatment at that time.

Clinical symptoms

The following symptoms were associated with a fat-pad impingement:

1. Anterior knee pain
2. Tenderness of the anterior soft tissue (Hoffa's fat pad) to palpation

Radiological findings

The radiological finding seen in the cases of a fat-pad impingement is demonstrated in Fig. 1: an anterior position of the A/P-Glide bearing is seen in flexion, decreasing the space for the fat pad between the anterior edge of the A/P-Glide bearing and the patellar ligament or the distal patellar pole.

PET-18F-FDG findings

The individual results are listed in Table 2. All subjects had increased FDG uptake in the involved knee. No or minimal uptake was noted in the contralateral asymptomatic knees, even when these knees were fitted with an arthroplasty (see Fig. 2).

Intraoperative findings

Macroscopic local necrosis and fibrosis of the fat tissue below the distal pole of the patella were found in all cases where a fat-pad impingement was anticipated. The polyethylene of the A/P-Glide bearing gave a clear imprint in the fat tissue (see Fig. 3). Such an imprint was not seen in the cases that were revised for other reasons.

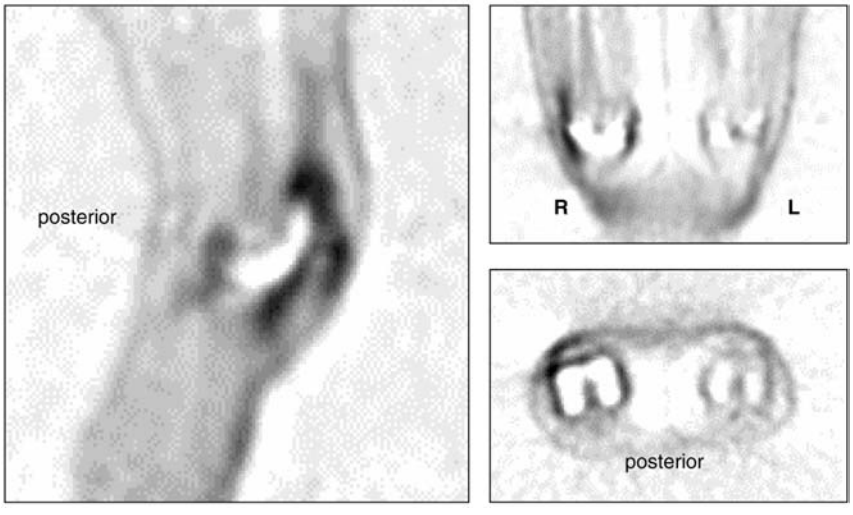

Fig. 2 Sagittal, coronal and axial view of a FDG PET-scan of a patient with both sided knee implants; high FDG uptake at the antero-lateral aspect of the right knee, where intraoperatively a fat-pad impingement was confirmed. The prosthesis is seen as a defect in FDG accumulation

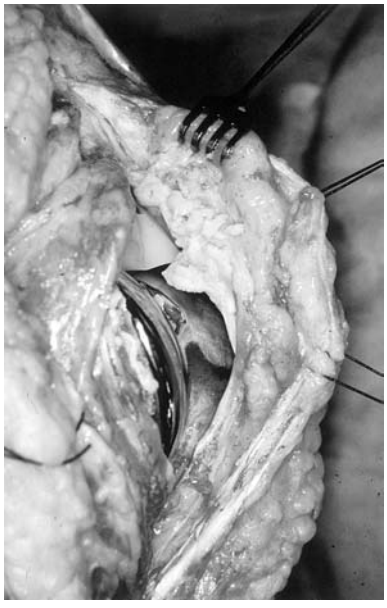

Fig. 3 Intraoperative findings. Macroscopic local necrosis and fibrosis of the fat tissue is present below the distal pole of the patella. The polyethylene of the A/P-Glide bearing gives a clear imprint in the fat tissue

Postoperative follow-up information

One year after the revision surgery five subjects were pain-free, five stated that their knee had improved and three complained about unchanged symptoms.

Discussion

The A/P-Glide component of the LCS knee-replacement system has a promising design as far as its kinematic ability and stability are concerned. However, unlike the previous LCS designs our early follow-up results with a total of 10.4% revisions demonstrated an increased revision rate. Whilst 4.8% of the cases were revised for commonly-recognised reasons, such as progressive ligament insufficiency, arthrofibrosis and component loosening, an additional 5.7% were revised as a result of finding the fat-pad impingement. This indicates the fat-pad impingement to be a new complication specific to the A/P-Glide design.

The fat pad has been described as an area with a high density of sensory nerve endings [26, 27], which explains the high rate of disabling pain. Dye [7] reported severe pain of the anterior synovium, the fat pad and the joint capsule when these structures were palpated arthroscopically in a self-assessment study. "Hoffa's disease" has been widely described by several authors [6, 9, 16, 18] as a cause for anterior knee pain, with serious functional implications in athletes and in subjects after anterior cruciate ligament reconstruction and other knee pathologies. After total knee replacements, other impingement problems have been widely described by several authors, such as: (a) impingement due to hypertrophic fibrous tissue or nodules in the intercondylar notch [4, 12], (b) impinging hypertrophic synovitis [5], (c) intraarticular fibrous plicae and bands [14, 24], (d) soft tissue under the patella consistent with the "clunk" syndrome [5, 15], (e) impinging PCL stump [5], (f) impingement caused by cement extrusion and proximal tibiofibular instability [19], and (g) fabellar impingement [8, 25]. Patellotibial impingement has been described by Grigoris [10] in Kinemax-stabilised total knee replacement and by Patel [20], who reported mild patellar impingement symptoms in 8% of 157 patients with a posteriorly-stabilised (Insall-Burstein) knee replacement.

With the A/P-Glide component, the Hoffa's fat pad was impinged between the anterior edge of the polyethylene bearing and the distal pole of the patella, causing anterior knee pain. In four knees (1.7%), revision surgery was planned to be performed later; in 13 knees (5.7%) revision surgery was performed, confirming the fat-pad impingement. Another 26 knees (11.3%) displayed mild-to-moderate symptoms. The high number of symptomatic cases indicates a significant complication resulting from this design. However, revision surgery for this specific problem is comparatively simple, since only the polyethylene component need to be exchanged.

The other cases revised for different reasons did not demonstrate fat-pad impingement. This complication appears to occur less frequently with the rotating-platform or meniscal bearing designs. Although the rotating platform has a similar shape of the polyethylene, an anterior impingement is not likely to occur due to the lack of anterior translation of the bearing. Meniscal bearings, however, translate anteriorly, but appear to impinge less due to a lack of polyethylene centrally.

Fat-pad impingement may be anticipated where there is a history of anterior knee pain and tenderness of the anterior region to palpation. The anterior position of the A/P-Glide polyethylene may be seen on radiographs. However, the final diagnosis is only confirmed intraoperatively where local tissue necrosis and fibrosis is found with an imprint of the bearing in the fat tissue. Up to now there are no imaging tools available to prove fat-pad impingement prior to revision. MRI has been described as capable of diagnosing alterations in the Hoffa's fat pad with high accuracy [9, 13, 17]. This imaging technique, however, is not feasible in the presence of an arthroplasty due to artefacts resulting from the implant. The results of the PET-18F-FDG scan in the five subjects who had access to this investigation technique in a pilot project suggest that this is a possible tool to visualise soft-tissue irritation. The location of the increased uptake was in agreement with the intraoperative findings of soft-tissue irritation due to the impingement. No uptake was seen in the asymptomatic contralateral knees, even when those knees were also fitted with an arthroplasty. The number of our subjects however is too small to be conclusive about the

sensitivity and the specificity of this imaging technique. Further investigation of this technique is needed to answer this question. Disadvantages of this technique are its cost and limited availability.

Conclusion

The Hoffa's fat-pad impingement is a complication in total knee replacement seen in systems with a central mobile-bearing component which has the freedom of anterior translation, such as the LCS A/P-Glide bearing. Since the fat pad is highly innervated, the impingement may cause anterior knee pain with functional implications necessitating early revision surgery. Resection of the Hoffa's fat pad is recommended when such an implant system is used, and possible impingement should be investigated intraoperatively before closure. Fat-pad impingement may be anticipated in cases complaining about anterior knee pain and demonstrating anterior soft tissue tenderness to palpation. The diagnosis is confirmed intraoperatively during revision surgery. As an imaging technique, PET-18F-FDG may be useful to visualise the soft tissue irritation prior to revision. However, due to the high cost of this technique and its limited availability other imaging techniques such as sonography should be evaluated as well.

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